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Issue Article

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REFERENCE DATA OF PRESSURE DISTRIBUTION ON THE SURFACES OF AIRFOILS HAVING THE NAMES BEGINNING WITH THE LETTER T

Abstract: *The results of the computer calculation of air flow around the airfoils having the names beginning with the letter T are presented in the article. The contours of pressure distribution on the surfaces of the airfoils at angles of attack of 0, 15 and -15 degrees in conditions of the subsonic airplane flight speed were obtained.*

Key words: *airfoil, angle of attack, pressure, surface.*
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Introduction

Creating reference materials that determine the most accurate pressure distribution on the airfoil surfaces is an actual task of the airplane aerodynamics.

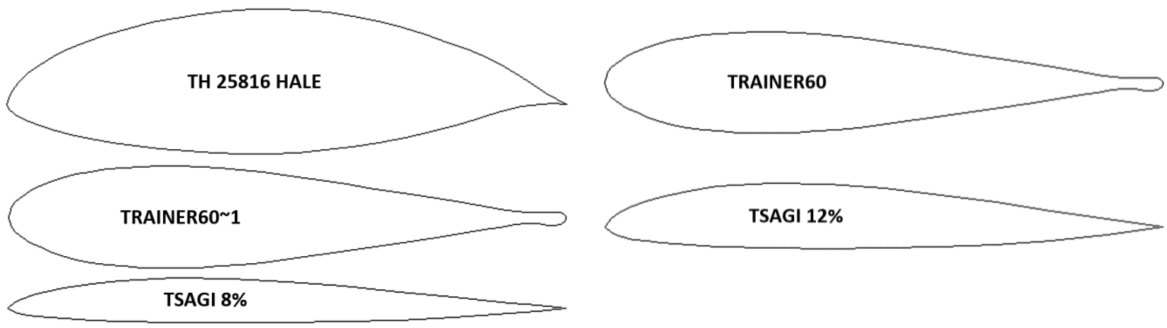
Materials and methods

The study of air flow around the airfoils was carried out in a two-dimensional formulation by means of the computer calculation in the *Comsol Multiphysics* program. The airfoils in the cross section were taken as objects of research [1-36]. In this work, the airfoils having the names beginning with the letter *T* were adopted. Air flow around the airfoils was carried out at angles of attack (α) of 0, 15 and -15 degrees. Flight speed of the airplane in each case was subsonic. The airplane flight in the atmosphere was carried out under normal weather conditions. The geometric characteristics of the studied airfoils are presented in the Table 1. The geometric shapes of the airfoils in the cross section are presented in the Table 2.

Table 1. The geometric characteristics of the airfoils.

Airfoil name	Max. thickness	Max. camber	Leading edge radius	Trailing edge thickness
TH 25816 HALE	25.72% at 47.0% of the chord	3.99% at 51.9% of the chord	2.0512%	0.0%
TRAINER60	18.31% at 27.1% of the chord	0.21% at 1.3% of the chord	3.3993%	0.6684%
TRAINER60~1	18.31% at 27.1% of the chord	0.21% at 1.3% of the chord	3.3993%	0.6684%
TSAGI 12%	11.9% at 30.0% of the chord	1.99% at 30.0% of the chord	0.963%	0.0%
TSAGI 8%	7.95% at 30.0% of the chord	1.34% at 30.0% of the chord	0.6883%	0.0%

Table 2. The geometric shapes of the airfoils in the cross section.



Results and discussion

The calculated pressure contours on the surfaces of the airfoils at different angles of attack are presented in the Figs. 1-5. The calculated values on the scale can be represented as the basic values when comparing the pressure drop under conditions of changing the angle of attack of the airfoils.

5 airfoils of the TH, TRAINER and TSAGI types were considered in this paper. All airfoils are asymmetrical. The largest and smallest thicknesses of the studied airfoils are 25.72% and 7.95% for TH 25816 HALE and TSAGI 8%, respectively. The largest and smallest cambers are 3.99% and 0.21% for TH 25816 HALE and TRAINER60 (TRAINER60~1), respectively. The largest and smallest leading edge radii are 3.3993% and 0.6883% for TRAINER60 (TRAINER60~1) and TSAGI 8%, respectively. The largest and smallest trailing edge thicknesses are 0.6684% and 0.0% for TRAINER60 (TRAINER60~1) and other airfoils, respectively.

The analysis of the aerodynamic characteristics of the airfoils was carried out according to the calculated values of pressures arising on the model surfaces at different angles of attack.

It is determined that the greatest and least drag acts on the leading edge of the TH 25816 HALE and TRAINER60 and TSAGI 8% airfoils during the horizontal flight of the airplane. Pressure changes for the studied airfoils are insignificant and amount to less than 1%. At the same time, the value of negative pressure decreases with a decrease in the thickness of the airfoil.

The airplane climb is characterized by an increase in positive pressure on the leading edge of all airfoils. However, the TSAGI 12% airfoil is subjected to the greatest negative pressure. It can be seen from the calculated pressure values that the thickness of the airfoils affects the value of negative pressure on the leading edge, i.e. pressure decreases with increasing thickness.

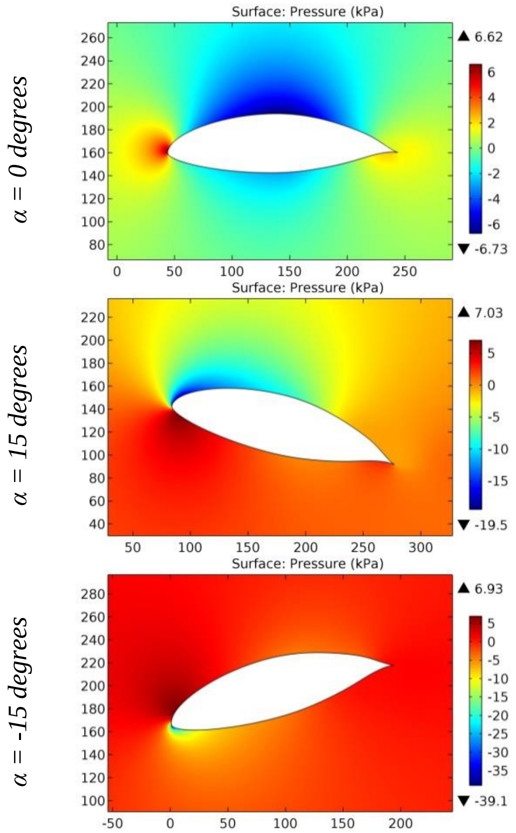


Figure 1. The pressure contours on the surfaces of the TH 25816 HALE airfoil.

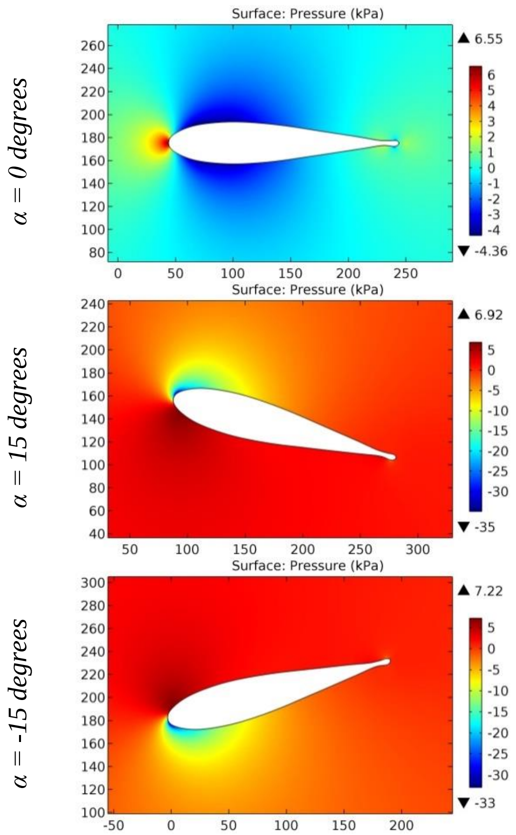


Figure 2. The pressure contours on the surfaces of the TRAINER60 airfoil.

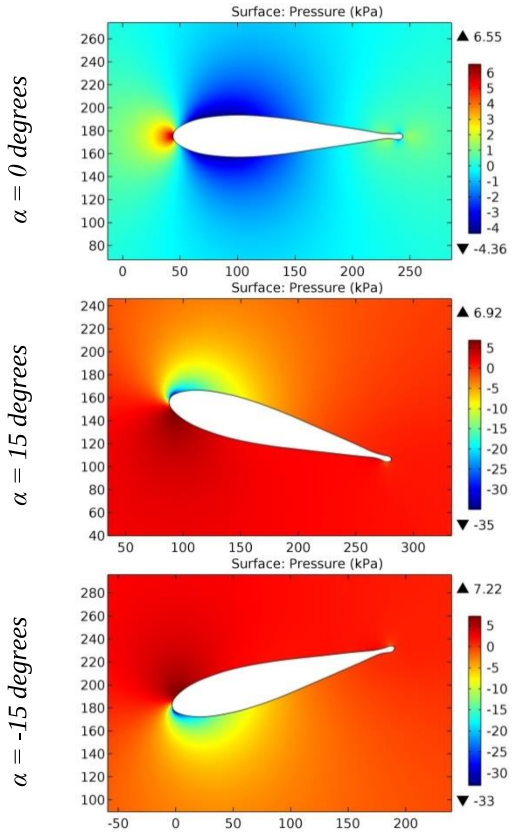


Figure 3. The pressure contours on the surfaces of the TRAINER60~1 airfoil.

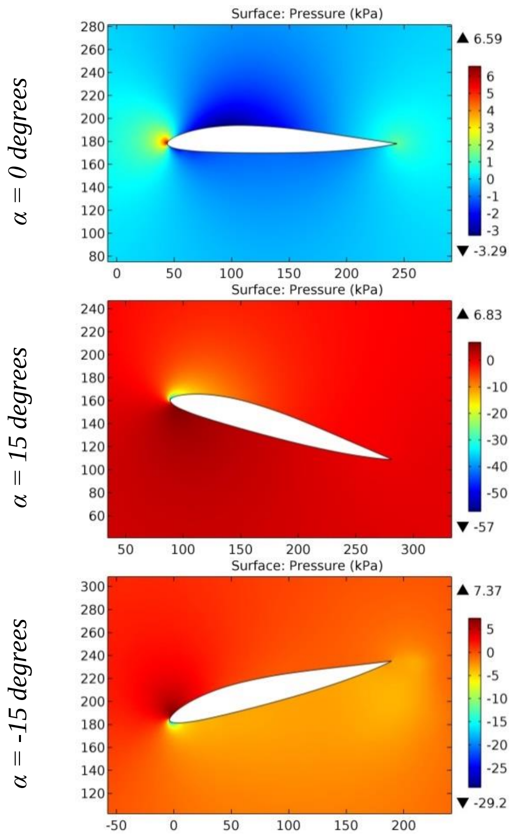


Figure 4. The pressure contours on the surfaces of the TSAGI 12% airfoil.

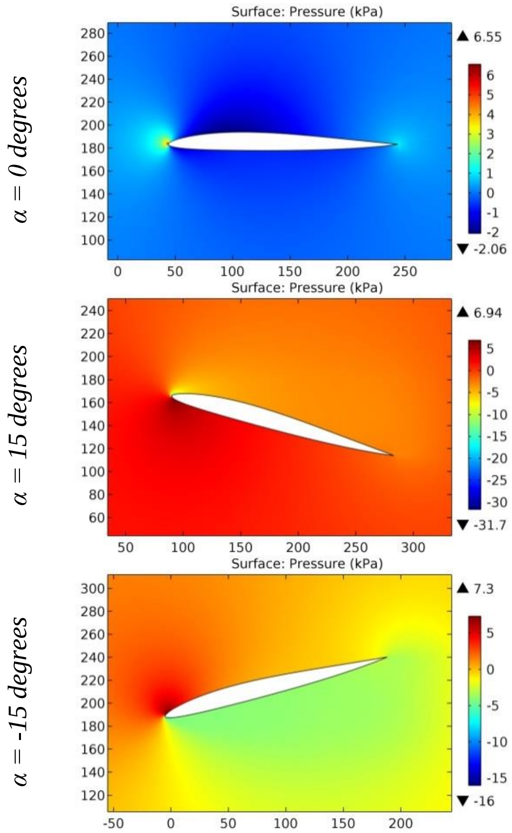


Figure 5. The pressure contours on the surfaces of the TSAGI 8% airfoil.

The airplane descent is characterized by a subsequent increase in positive pressure on the leading edge, compared with the horizontal flight and the climb maneuver. The exception is the TH 25816 HALE airfoil, which is subjected to less positive pressure at a negative angle of attack than at a positive angle of attack. It is also noted that the negative pressure during the climb is higher than during the descent. The TH 25816 HALE airfoil is also an exception in these conditions.

Conclusion

Thus, these configurations of the airfoils do not lead to the formation of high pressures on the surfaces of the airplane wings in the range of selected angles of attack. In conditions of the horizontal flight of the airplane, the radius size of the leading edge has a greater effect on the pressure distribution area, and to a lesser effect on the change in the pressure value. At the same time, during the airplane climb, positive pressure on the leading edge of the airfoils is less in the value than during the airplane descent. However, negative pressure is greater during the climb maneuver of the airplane than during the descent maneuver. The exception is the TH 25816 HALE airfoil.

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